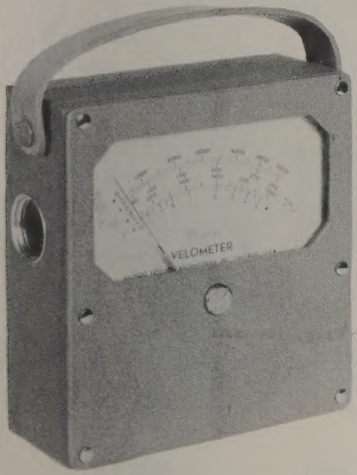
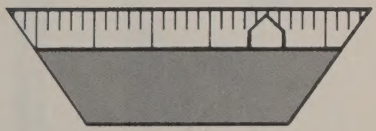
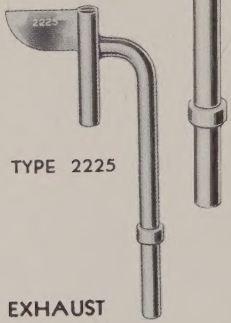
Instructions For The *Alnor*® Velometer®





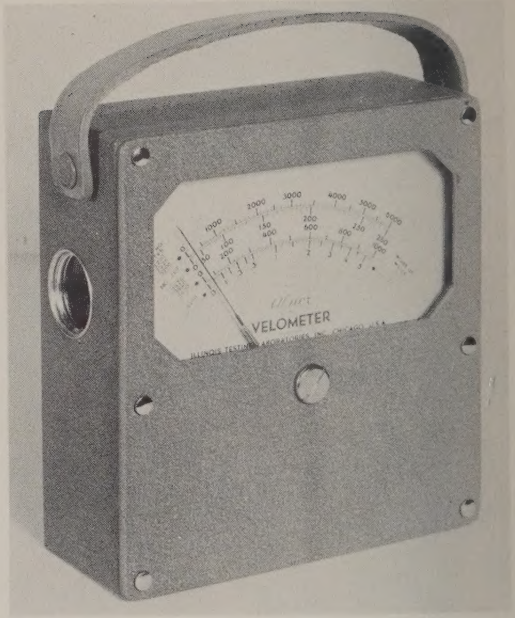
.NOR INSTRUMENT COMPANY
Division of
llinois Testing Laboratories, Inc.
420 North LaSalle Street
Chicago 10, Illinois

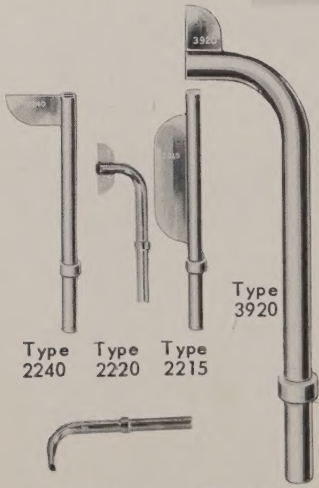
TYPE 3930



TYPE 2225

EXHAUST OPENINGS





Type 3920

Type 2240 Type 2220 Type 2215

Type 2230 Diffuser Jet

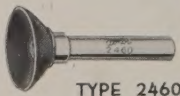
SUPPLY OPENINGS

TYPE 2420

Type 2778

TYPE 2245 TUBE FITTING

TYPE 3905 TUBE FITTING



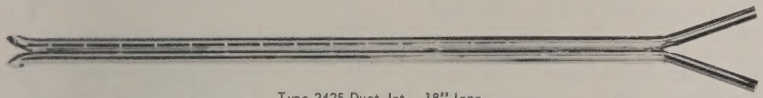
TYPE 2460

STATIC PRESSURE

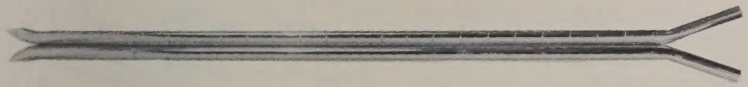
TYPE 3150 AND SPARE FILTER ELEMENT, 2726

Type 2595 Duct Tool

Type 3290 Duct Jet 9" long



Type 2425 Duct Jet – 18" long

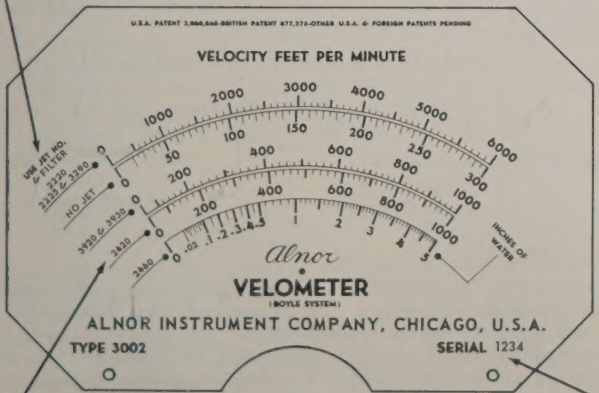


Type 3910 Duct Jet – 24" long

Type 2485 Total Pressure Jet

VELOCITIES IN DUCTS

Filter must always be used if the meter was originally equipped with one.



Use scale with type designation for the jet being used.

TYPICAL SCALE

Serial number of meter and jets must agree.

The Velometer is an instrument for measurement of the velocity and pressure of air. The instrument is generally equipped with a set of "jets" and orifices" each of which is calibrated for its particular instrument. Each Velometer has a serial number on the scale face. The same number is shown on each of its jets or orifices. The jet, tube, and instrument are a calibrated system. Unless it is otherwise stated the instrument is calibrated for standard tubes 28 inches long.

The Type Numbers of every jet, with which any particular Velometer is equipped, are shown at the left of the scale. The type number is in line with the arc which is to be read when that particular jet is used. It is quite common to have more than one jet for a specific arc or range.

The "zero setting" should be checked once in a while. To do this cover both meter ports with your hands to be sure there is no air flow through the instrument. If the pointer does not come to zero, turn the "zero adjuster" on the front of the meter until the pointer does come to rest at zero. The instrument movement is balanced so that it may be used in any position. If in doubt about the balance, hold the instrument horizontally.

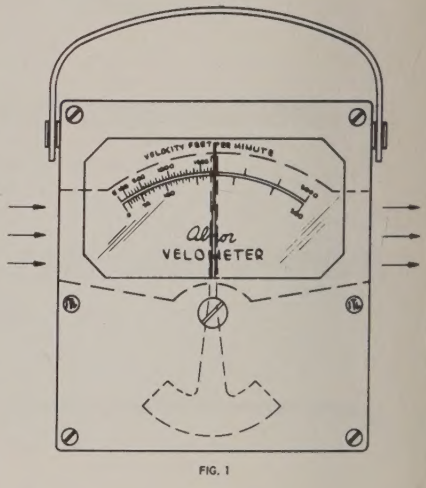


FIG. 1

When equipped with suitable jets, the Velometer can be used for measuring air velocities in each of the following situations:

1. Velocity in a room or other large space.
2. Velocity at a supply opening.
3. Velocity at a suction opening.
4. Velocity inside of a duct.

It can also be used to measure:

5. Static Pressure
6. Total Pressure

Principle of Operation

The Velometer with its accessory equipment is a high quality, rugged mechanical system soundly engineered. The design and construction achieve dependability and accuracy of calibration and no compromise is made. Inside the meter, air impinges on an aluminum vane, thus deflecting the pointer up scale. This vane travels in a calibrated air chamber or tunnel painstakingly constructed to be pressure tight and to provide a desirable scale distribution.

The moving system is carefully balanced by means of counter-weights, to provide accuracy regardless of meter position. The moving system is loaded by means of highest quality phospher bronze hair springs, and moves on the best pivots achievable. The pivots have monel (for toughness) shanks and osmium (for hardness) tips. The pivots ride in genuine sapphire jewels.

The system is calibrated in terms of velocity units at the jets or orifices. Therefore, each jet is calibrated for one scale on one instrument; the scales being individually stepped and hand drawn. Jets may not be interchanged, and whenever a Velometer is to be repaired or jets added, all of the jet equipment must be returned with the instrument.

Filters

Some velometers are equipped with filters to protect them from extreme dust conditions. When a filter is supplied with the instrument, it is a portion of the calibration. It should never be left off the instrument even though a measurement is being made on clean air.

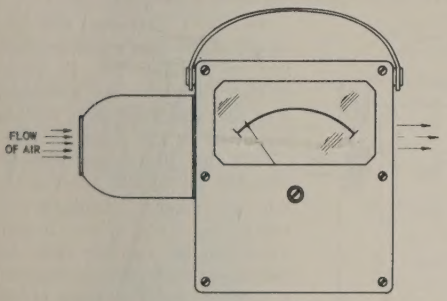


FIG. 2
VELOMETER WITH FILTER
(NO JET RANGE)

If a Velometer was originally equipped and calibrated with a filter, the filter should always be used in addition to the jets, tubes, fittings and orifices discussed below.

If a Velometer was originally equipped with a filter, it will be indicated on the left side of the scale by the legend "Use Jet No._____ and Filter".

In actual use the filter element area is quite large in proportion to the amount of air flowing through it. Therefore, it will be found that it does not readily get dirty to the point where readings are affected. However, if due to continued use in extremely dirty atmospheres it does clog, this will cause the instrument to read low. This will be most noticeable on the low ranges. In such a situation the filter element should be cleaned by blowing it off with compressed air or by washing it in a solvent such as carbon tetrachloride.

Velocities in Open Spaces

No Jet, 2778 and 2420 Orifices

The instrument should be held in the air stream so that the air impinges directly on the left hand meter port. If the direction of the air stream is not known, turn the instrument to various positions until the maximum indication is obtained.

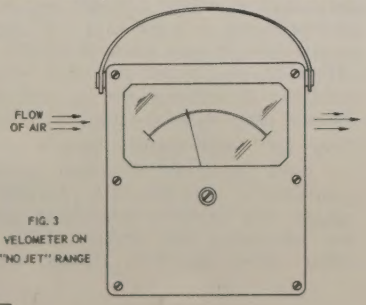


FIG. 3
VELOMETER ON
"NO JET" RANGE

For low velocities the Velometer is used without attachments of any kind (excepting filter if so equipped) and read on the "no jet" scale (usually 0-200 or 0-300 fpm).

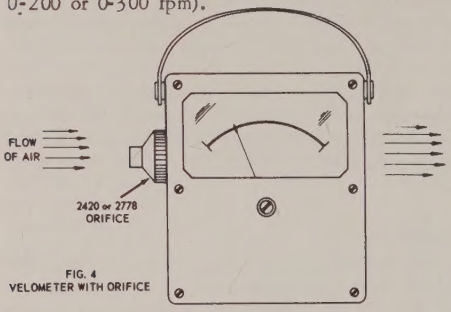


FIG. 4
VELOMETER WITH ORIFICE

Instruments with a low range of 0-300 to 0-800 fpm are usually equipped with a 2778 orifice. This orifice should be screwed into the left hand port or in the filter if supplied and the instrument held in the air stream so that the stream impinges directly on the orifice. If the direction of the air flow is unknown, turn the instrument to obtain the maximum reading. Read the scale marked 2778.

The 2778 orifice is supplied at the manufacturer's discretion, at no extra charge, when an orifice is necessary to achieve the lowest range.

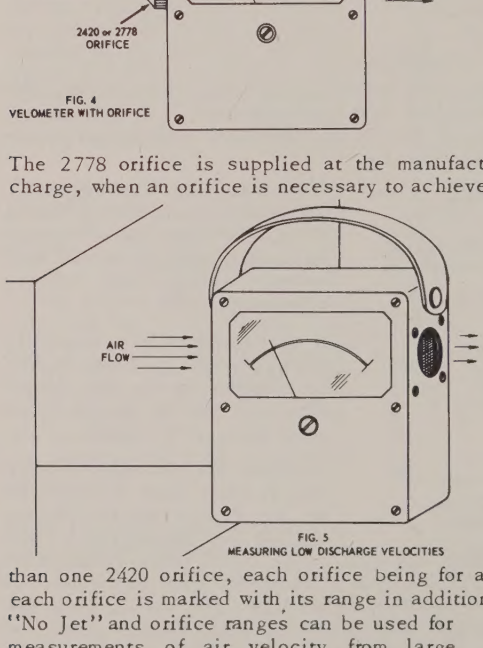


FIG. 5
MEASURING LOW DISCHARGE VELOCITIES

Type 2420 Orifices can be supplied for ranges of 0-1000 fpm to 0-6000 fpm. A 2420 orifice should be screwed into the left hand port of the meter (or in the filter if supplied). The instrument should be held in the air stream so that the stream impinges directly on the orifice. If the direction of the air flow is unknown, turn the instrument to obtain the maximum reading. Read the scale marked 2420. Occasionally, a Velometer is equipped with more than one 2420 orifice, each orifice being for a different range. In this case, each orifice is marked with its range in addition to its Type Number.

"No Jet" and orifice ranges can be used for measurements of air velocity from large discharge openings. These ranges are not recommended for openings of less than 2 square feet in area because of the blocking effect of the instrument. For best results hold the instrument one to two inches in front of the supply opening.

"No Jet" and orifice ranges should not be used in front of return grilles when quantitative results are desired. These ranges are however sometimes convenient for comparing one return grille with another when the two grilles are approx-

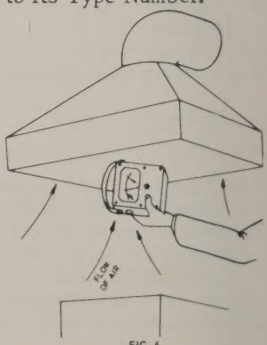


FIG. 6
VELOCITIES AT HOOD FACE

imately the same size. "No Jet" and orifice ranges may be used for large exhaust openings such as spray booths and large exhaust hoods. For maximum accuracy, the instrument should be held so that the left hand port is even with the entry edge of the booth or hood.

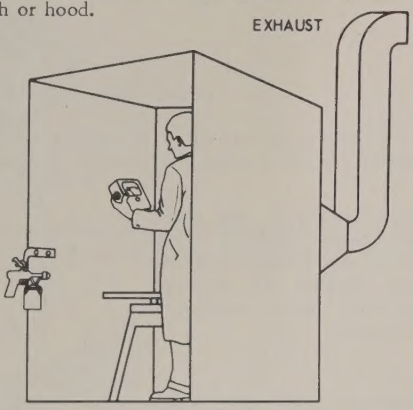


Fig. 7
SPRAY BOOTH (NO JET RANGE)

Air Velocity at Supply Openings

Jets 3920, 2220, 2230, 2240, 2215

To measure air velocities at supply openings, attach any one of the above jets to the left hand side of the instrument by means of the appropriate tube and tube fitting (3905 fitting and 5/8" I.D. tubing for 3920 Jet; 2245 Fitting and 3/8" I.D. tubing for others). Hold the jet so that the air impinges directly on the opening. Hold the instrument any place outside of the main air stream.

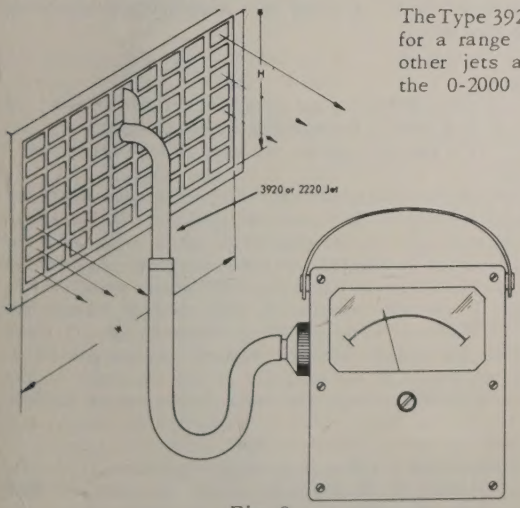


Fig. 8
MEASURING VELOCITIES AT DISCHARGE OPENING

The Type 3920 Jet is generally supplied for a range of 0-1000 fpm. All of the other jets are generally supplied for the 0-2000 fpm and higher ranges.

The type 2220 and 2240 Jets are identical in function. Convenience dictates which of these two jets is used. Most Velometer sets have only one of these jets – generally the 2220. The fin on the 2220 jet is now held in place by means of a snap ring and can therefore be easily removed.

The Type 2230 Jet was designed specifically for use on ceiling diffusers, narrow slot openings, and similar applications.

The Type 2215 Jet gives an average velocity along a 4" line, thus reducing the number of readings required when running a traverse.

Always read the scale marked with the type number of the jet you are using.

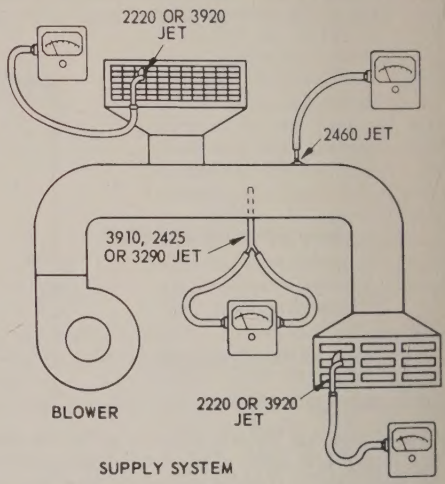


Fig. 9

When it is necessary to determine the CFM output of a supply opening, having no grille, use the following equation:

$$Q = A\,\overline{V}$$

where

Q = quantity of air in cubic feet per minute
A = area of the opening in square feet
$\overline{V}$ = the average air velocity in feet per minute

To determine the average velocity mentally divide the opening into a number of equal areas. Take a single reading at the center of each area and average these readings. There is no exact rule for the number of areas to be used. In general, the greater the number of readings, the more accurate the results will be. It is good practice to take at least 6 readings and rarely necessary to take more than 20 readings. If the air velocity is quite uniform across the opening, good results can be obtained with relatively few readings. If there is a great variation between the lowest and the highest reading, a larger number of readings should be taken. If the velocity is not constant at one spot so that the pointer is pulsing, accept the mean between the highest and lowest indications.

If the supply opening is covered by a grille it is suggested that the jet be held approximately one inch in front of the grille to obtain the velocity reading. When this is done, the A in the above equation is the core area of the grille ("W" times "H" in Fig. 8).

Some manufacturers specify a "coefficient of discharge" for their grilles. When this coefficient is known, the jet should be held against the grille to obtain the velocity reading and the following equation applied.

$$Q = k\ A\ \overline{V}$$

where

k = coefficient of discharge

When the velocity distribution is quite uniform it is frequently possible to to obtain a satisfactory average velocity by slowly "sweeping" the jet across the grill and mentally averaging the velocities.

For openings covered by a diffuser see instructions for that specific type of diffuser. Most diffuser manufacturers have these instructions for their product.

Suction Openings (Return or Exhaust)

Jets 2225 or 3930

Jet No. 2225 is generally supplied for a range of 0-2000 fpm or higher. Jet No. 3930 is generally supplied for a range of 0-1000 fpm.

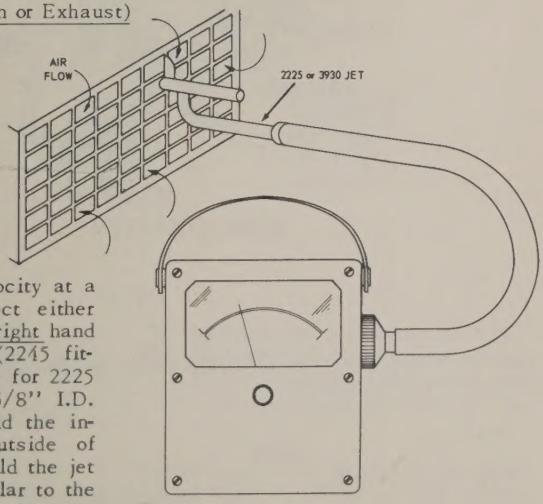


Fig. 10
MEASURING AIR VELOCITY AT A SUCTION OPENING

To measure the air velocity at a suction opening, connect either jet 2225 or 3930 to the right hand port of the Velometer (2245 fitting and 3/8" I.D. tube for 2225 jet; 3905 fitting and 5/8" I.D. tube for 3930 Jet). Hold the instrument any place outside of the main air stream. Hold the jet so that it is perpendicular to the opening and so that the tip is in the same plane as the opening. This is very important because velocities are changing very rapidly in front of a suction opening.

When it is necessary to determine the CFM flowing into a suction opening, the correct procedure is to take a multiplicity of readings at the center of equal areas as in the case of supply openings, and compute the average face velocity. Suction openings are more apt to have a fairly uniform face velocity than will be found at supply openings. It is, therefore, frequently possible to obtain quite satisfactory results by taking a single center velocity reading and assuming that this is the average velocity.

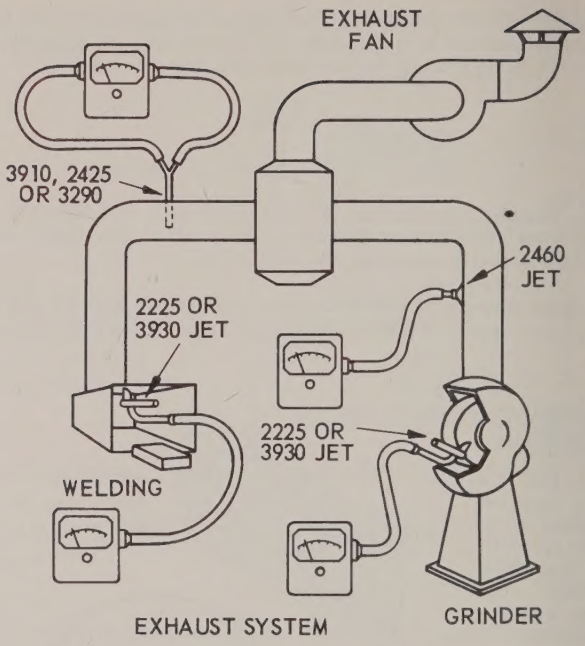


Fig. 11

After the average velocity has been determined the flow rate can be computed by the following equation.

$$Q = F\ A\ \overline{V}$$

where

Q = CFM
F = Application factor
A = designated area in square feet

$\overline{V}$ = Average fpm

The following factors should be used

Grille	F	Designated Area
Free Open (No Grille)	1.00	Full Duct Area
Square Punched Grille	.88	Free (Daylight) Area
Bar Grille	.78	Core Area
Steel Strip Grille	.73	Core Area

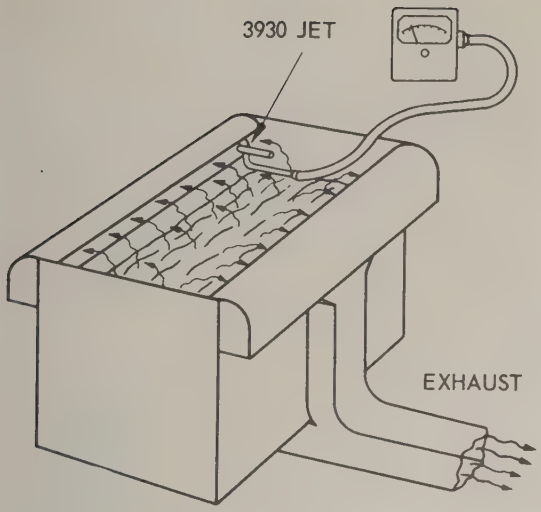


Fig. 12

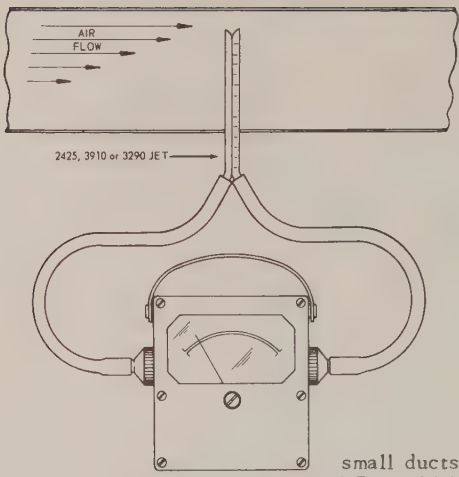
Do not attempt to make quantitative CFM determinations by holding the Velometer itself (no jet range or equipped with 2778, or 2420 orifice) in front of a suction grille. All readings will be high due to the static pressure drop across the instrument. It is of course, possible to make comparative readings on two or more similar grilles in this manner.

Quantitative volume readings can be made at the face of large suction openings such as spray booths and hoods using the no jet, 2778, or 2420 orifice ranges. The openings are not equipped with grilles so the instrument can be held inside the opening where the static pressure is stable.

Velocities Inside Ducts

Jets No. 2425, 3290, 3910

When it is possible to make a measurement inside of a long straight run of duct (preferably at least 10 diameters downstream from the nearest turn, transformation, damper or other source of turbulence), this location should be selected in preference to all others. At such a location, the air flow is most nearly ideal for velocity measurements.



MEASURING VELOCITIES INSIDE A DUCT

Fig. 13

To measure velocities inside of a duct, use duct jets 2425, 3290 or 3910. The duct jets should be connected to both sides of the Velometer by means of tubes and tube fittings provided (3/8" I.D. tubing and 2245 tube fittings for 2425 and 3290 jets; 5/8" I.D. tubing and 3905 tube fittings for the 3910 duct jet). If the instrument is equipped with a filter, it should of course be attached to the left hand (inlet) port.

3910 duct jets are usually supplied for 0-1000 FPM ranges. For ranges of 0-2000 FPM and higher, the 2425 duct jet is usually supplied. However, for small ducts where the range will be 0-4000 FPM or higher the 3290 may be supplied.

The instrument may be held in any position. When used with a duct jet, the indications are entirely independent of air velocities around the meter. It is important that the tubes and fittings be tight, since a leak in the system may cause errors.

The duct jet should be inserted into the duct so that the air will impinge directly on the side of the jet connected to the left hand meter port.

Read the scale marked with the type number of the jet you are using. The meter indicates the air velocity at the tip of the duct jet.

Since air velocities are rarely uniform across a duct, it is necessary to determine the average velocity to compute CFM. Measurements should be made at the centers of equal areas. In general, the greater the number of readings taken the better the accuracy will be. Duct Jets are marked in inches.

For rectangular ducts, mentally divide the duct into at least nine equal areas (preferably more) that are approximately square. Take readings at the centers of these areas and average them.

For round ducts, a total of 20 readings is the best practice; 10 readings across each of two diameters at right angles to each other. The locations of the centers of equal areas are shown in figure 14. Six and eight point traverses are also shown and are used to save time, but of course, are not as accurate.

A quicker, though less accurate method, may be used for field testing when a long, (at least 10 dia.) straight run of duct is available. Never use this method if such a straight run of duct is not available. Take a single center line reading and multiply by .9 to obtain an estimated average velocity.

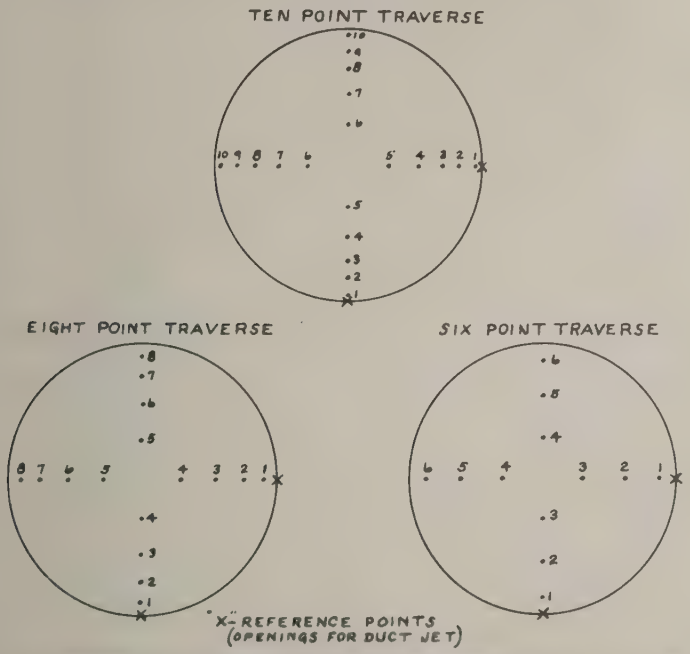
When the average velocity has been determined the flow rate can be computed by the following equation:

$$Q = A\,\overline{V}$$

where

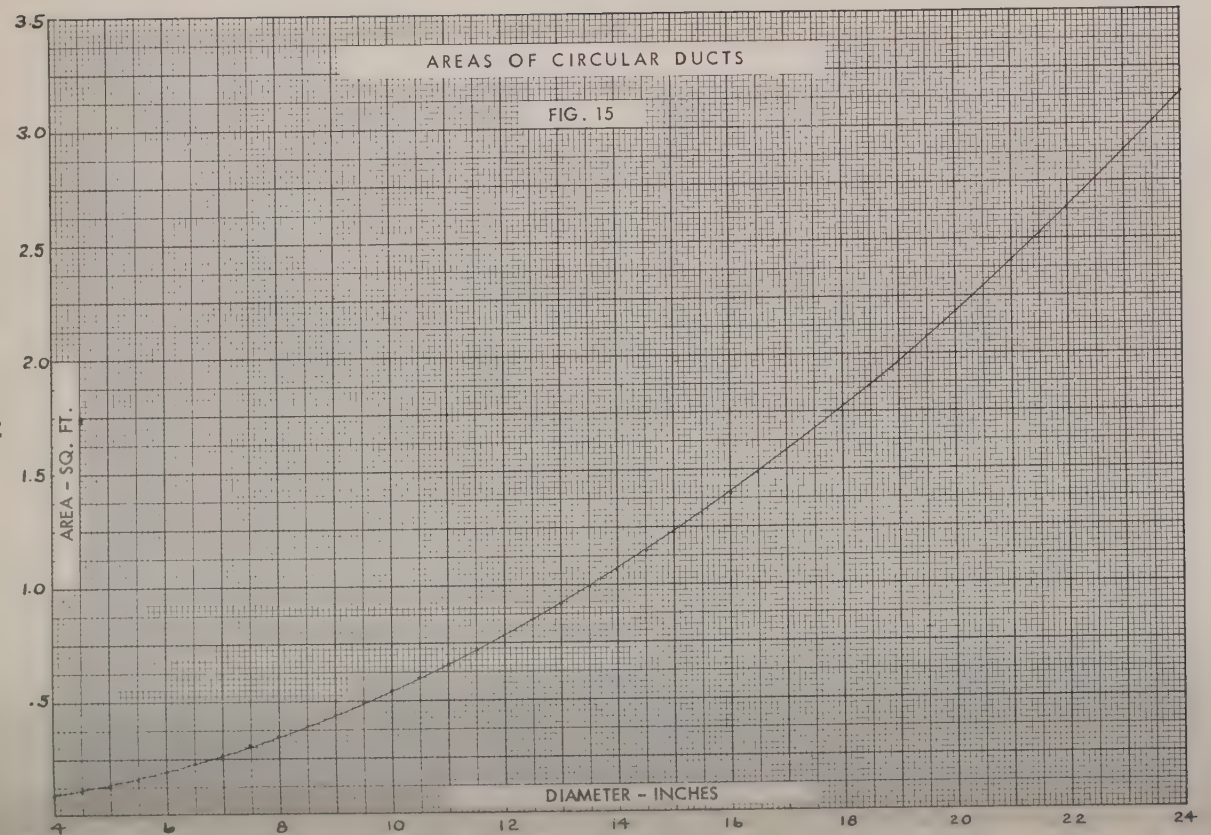
Q = cubic feet per minute
A = area of duct in square feet
$\overline{V}$ = average air velocity in feet per minute

CENTERS OF EQUAL AREAS - CIRCULAR DUCTS



DIMENSIONS FROM REFERENCE POINTS EXPRESSED IN PIPE DIAMETERS										
NUMBER OF POINTS	1	2	3	4	5	6	7	8	9	10
6	.043	.147	.296	.704	.853	.957				
8	.032	.105	.194	.323	.677	.806	.895	.968		
10	.025	.082	.146	.226	.342	.658	.774	.854	.918	.975

Figure 14


AREAS OF CIRCULAR DUCTS
FIG. 15
AREA - SQ. FT.
3.5
3.0
2.5
2.0
1.5
1.0
.5
DIAMETER - INCHES
4
6
8
10
12
14
16
18
20
22
24

Six Point Traverse
(Calculated From Figure 14)
Centers of Equal Areas – Inches From Reference Point

Duct Diam. Inches	Point					
	1	2	3	4	5	6
4	1/8	5/8	1-1/8	2-7/8	3-3/8	3-7/8
6	1/4	7/8	1-3/4	4-1/4	5-1/8	5-3/4
8	3/8	1-1/8	2-3/8	5-5/8	6-7/8	7-5/8
10	3/8	1-1/2	3	7	8-1/2	9-5/8
12	1/2	1-3/4	3-1/2	8-1/2	10-1/4	11-1/2
14	5/8	2	4-1/8	9-7/8	12	13-3/8
16	3/4	2-3/8	4-3/4	11-1/4	13-5/8	15-1/4
18	3/4	2-5/8	5-3/8	12-5/8	15-3/8	17-1/4
20	7/8	3	6	14	17	19-1/8
24	1	3-1/2	7-1/8	16-7/8	20-1/2	23

For Speed or Small Size Circular Ducts Use This Table

Table 1

Ten Point Traverse
(Calculated From Figure 14)
Centers of Equal Areas – Inches From Reference Point

Duct Dia. In.	Point									
	1	2	3	4	5	6	7	8	9	10
4	1/8	3/8	5/8	7/8	1-3/8	2-5/8	3-1/8	3-3/8	3-5/8	3-7/8
6	1/8	1/2	7/8	1-3/8	2	4	4-5/8	5-1/8	5-1/2	5-7/8
8	1/4	5/8	1-1/8	1-3/4	2-3/4	5 1/4	6-1/4	6-7/8	7-3/8	7-3/4
10	1/4	7/8	1-1/2	2-1/4	3-3/8	6-5/8	7-3/4	8-1/2	9-1/8	9-3/4
12	1/4	1	1-3/4	2-3/4	4-1/8	7-7/8	9-1/4	10-1/4	11	11-3/4
14	3/8	1-1/8	2	3-1/8	4-3/4	9-1/4	10-7/8	12	12-7/8	13-5/8
16	3/8	1-1/4	2-3/8	3-5/8	5-1/2	10-1/2	12-3/8	13-5/8	14-3/4	15-5/8
18	1/2	1-1/2	2-5/8	4-1/8	6-1/8	11-7/8	13-7/8	15-3/8	16-1/2	17-1/2
20	1/2	1-5/8	2-7/8	4-1/2	6-7/8	13-1/8	15-1/2	17-1/8	18-3/8	19-1/2
22	1/2	1-3/4	3-1/4	5	7-1/2	14-1/2	17	18-3/4	20-1/4	21-1/2
24	5/8	2	3-1/2	5-3/8	8-1/4	15-3/4	18-5/8	20-1/2	22	23-3/8

Use this table when accuracy is required

Table 2

Static Pressures

Jet No. 2460

To measure the static pressure in a duct, drill (do not punch) a hole at least 3/8" in diameter in the duct. A punched hole leaves a ragged edge which may cause large errors.

Use the type 2460 Static Pressure Jet. For positive (above atmospheric) pressures, connect the jet to the left hand port of the meter with the 3/8" I.D. tube and 2245 tube fitting. For negative (below atmospheric pressures) connect the jet to the right hand meter port.

The 2460 Jet is calibrated for zero flow conditions. Due to aspiration at the jet tip, there is some error when the velocity in the duct is high. For air velocities encountered in air conditioning service, this error is small. When the jet is used to measure pressure differences between two points (such as static drop across a filter) this error cancels out. When measuring static drops, it is important that the duct area at both measuring stations be identical because static pressure and velocity pressure are mutually convertible. Because of the possibility of measuring a velocity component, a static pressure measurement near an elbow is meaningless.

Total Pressure

Jet No. 2485

Total pressure is measured by means of a type 2485 total pressure jet. Drill a 3/8" hole in the duct or use the opening made for a duct jet. When measuring positive total pressures (discharge side of the fan) connect the jet to the left hand meter port by means of the #2245 fitting and the 3/8" I.D. tubing. When measuring negative total pressure (suction side of the fan) connect the jet to the right hand meter port. Hold the jet so that the air stream impinges directly on the jet opening. Read the scale marked 2485.

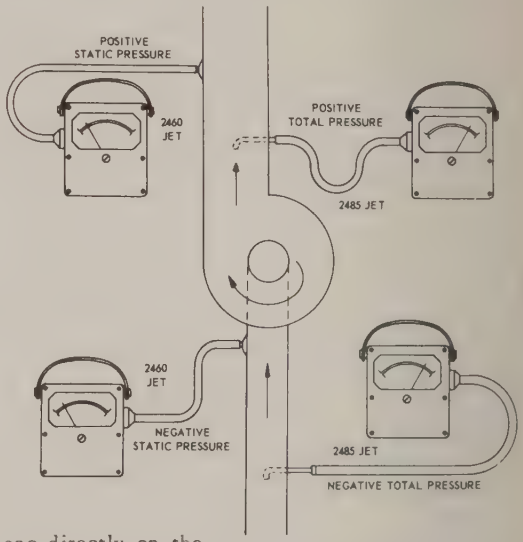


Fig. 16

Corrosive Atmospheres

The interior construction of the instrument is aluminum and steel which is not intended for use on corrosive gases. However, the rate of flow through the instrument is quite low (.25 CFM for full scale deflection). Therefore, for intermittent service the rate of corrosion will be very slow.

Repair, Recalibration, Addition of Jets

Return the complete set to Alnor Instrument Company where the necessary facilities and parts are maintained. It is always necessary to return all jets, tubes, and fittings with the instrument. Scales are individually hand drawn for the jet or jets to be used on a particular range. In repair or jet addition work, all jets must be on hand for checking and recalibration as necessary. In any correspondence regarding a Velometer refer to the instrument serial number.

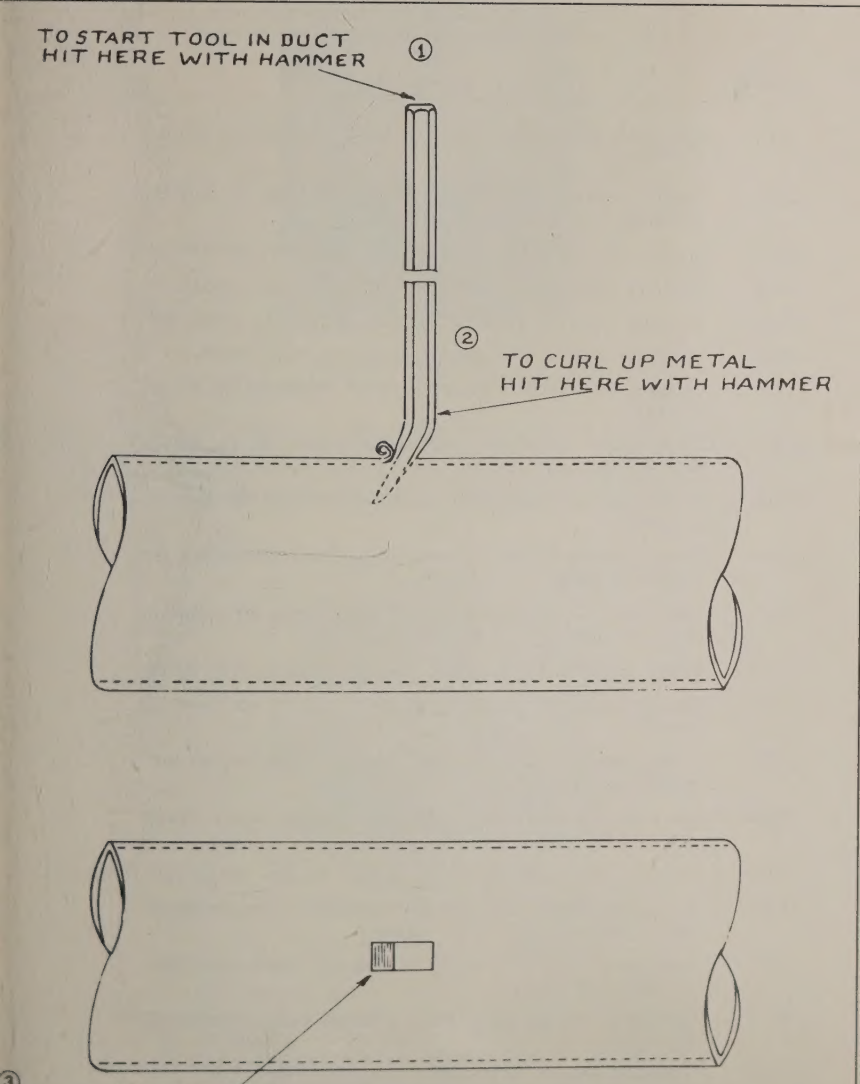
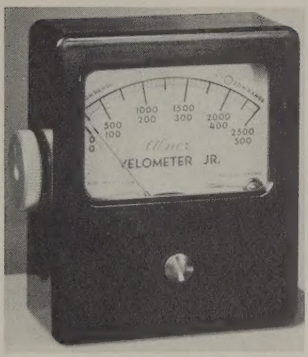

TO START TOOL IN DUCT
HIT HERE WITH HAMMER
①
②
TO CURL UP METAL
HIT HERE WITH HAMMER
③
TO CLOSE OPENING
UNCURL METAL

Fig. 17

Type Number	Application	Reference Page
2215	Averaging jet used to measure supply velocities along a 4" line	5
2220	Angle jet used to measure spot velocities at supply openings	4
2225	Intake jet used to measure suction (exhaust) velocities	6
2230	Diffuser jet for ceiling diffusers and narrow slot openings	5
2240	Straight jet for spot velocities at supply openings	4
2245	Fitting used with tubes for attaching high range jets	4, 6, 9
2420	Orifice jet attached at left port of meter (or at filter if used)	3
2425	Duct jet for measuring velocities inside ducts. Made of 3/8" O.D. tubing	9
2460	Static jet for measuring static pressures in inches of water	12
2485	Total pressure jet for measuring total pressures in inches of water	13
2595	Duct tool – a special chisel convenient for opening ducts for duct jets type 3290 and 2425.	14
2726	Filter element. Replaceable element used in 3150 filter	2
2778	Orifice attached at left port of meter (or at filter if used)	3
3150	Filter complete with a 2726 element. Attached at left port of meter.	2
3290	Duct jet for measuring velocities inside ducts. Made of 1/4" O.D. tubing	9
3905	Fitting used with tubes for attaching low range jets	4, 6, 9
3910	Low range intake jet used to measure suction (exhaust) ducts. Made of 5/8" O.D. tubing	9
3920	Low range angle jet used to measure spot velocities at supply openings	4
3930	Low range intake jet used to measure suction(exhaust) velocities	6
2161	Standard length tubes 28". Standard sizes 3/8" I.D.	–
3915	Standard Length tubes 28". Standard size 5/8" I.D.	–

Table 3



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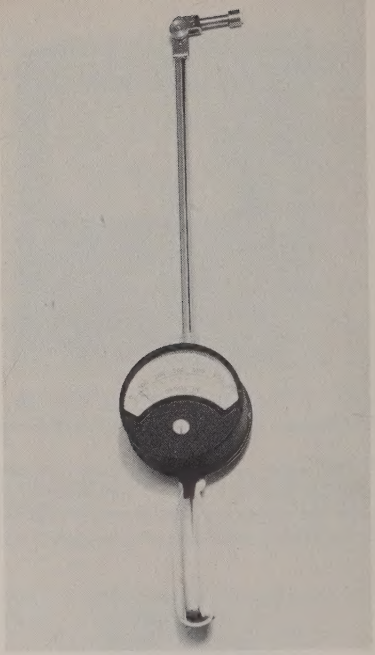

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